A structured approach to onshore and offshore wind turbine gearbox maintenance

Words: David Morgan, Business Manager – Wind Energy, ZF Services UK Ltd.

Despite the scale and rapid growth of the wind industry, it has until recently been challenged by the limited service options available for the maintenance and overhaul of turbine gearboxes. We take a look one company’s forward-thinking solution.
The UK wind energy market comprises more than 4,000 onshore and offshore wind turbines, with around 1,400 more currently under construction and thousands more at various stages of the planning process. Maintaining a wind turbine gearbox in first-class condition ensures that it is capable of delivering its rated performance safely and reliably under heavy and fluctuating loads. If the gearbox sustains damage, the turbine’s condition rapidly deteriorates, often rendering it inoperative and no longer generating revenue. Catastrophic turbine failure may lead to a major shutdown of all or part of a wind farm and as the number and size of offshore installations grows, the cost of such a shutdown will continue to increase.

The overhaul challenge
Preventive maintenance is a key factor in limiting the downtime of a wind turbine. Until now though, obtaining access to diagnostics and repair programmes within a narrow timeframe has not always been a viable option for UK wind farm operators. In the majority of cases, a failed unit or part would be shipped back to its Original Equipment Manufacturer (OEM) outside the UK for repair, inevitably extending the interruption of power generation.

ZF Services UK Ltd therefore set out to investigate whether extending its capabilities to include a UK-based wind turbine gearbox inspection and overhaul service would enable wind farm operators to maximise turbine uptime. The company initially consulted with the UK’s major wind
turbine operators to understand the challenges they faced in keeping wind-driven generating equipment operating at peak performance.

This approach proved welcome, and the decision was subsequently taken to invest in dedicated tooling and handling facilities to diagnose and overhaul wind turbine gearboxes. To reduce loss of energy production to a minimum during repair, the company also invested in a variety of swing units which can be made available to wind farm operators to keep turbines operational.

Some three years later, the company is firmly established as a leading multi-brand gearbox service provider to the UK’s wind energy sector, and offers a localised service incorporating preventive maintenance, unit overhaul and field support and has already achieved ‘approved supplier’ status with five of the UK’s top wind farm operators. With strong growth forecast in the wind energy market, increased demand is expected for on-site fault finding and diagnostic support, particularly for offshore wind farms located in British waters.

The overhaul process

To date, gearboxes serviced in the wind turbine overhaul facility have ranged from three tonnes to 11.5 tonnes in weight, but the lifting gear and test rig are capable of handling gearboxes of up to 30 tonnes. Future plans include expanding this capability to manage larger gearboxes from the latest generation of offshore turbines. Maintenance and repair of gearboxes can include items such as brakes, oil coolers, torque arms, rotor shaft repairs, gear analysis using video endoscopy and oil analysis. A typical work sequence is outlined below.

**Gearbox condition report**

On arrival the turbine gearbox and its ancillaries are visually checked before being completely stripped, cleaned and inspected by industry trained technicians. During disassembly, the condition of internal components is examined and recorded with failure mode and cause noted where applicable. A comprehensive gearbox condition report is then produced, detailing the probable cause of failure and the work required to return it to serviceable condition. Once agreed with the customer, work begins on rebuilding the gearbox.

**Re-use, remanufacture or replace?**

During overhaul, bearings and seals are replaced. Gears, shafts, and bores are measured to assess whether components are within tolerance and can be safely re-used, or require specialist refurbishment or replacement. To save cost and time, damaged gears within tolerance can often
TALKING POINT

Current and future developments

During the past two years, ZF has become increasingly involved at the manufacturing level in the wind turbine arena. The company began expanding its activities by building a wind turbine gearbox manufacturing plant in Gainesville, USA. Subsequently, ZF Friedrichshafen AG acquired leading wind turbine gearbox manufacturer Hansen Transmissions International NV, which now trades as ZF Wind Power Antwerpen.

These developments complement ZF’s gearbox overhaul and maintenance service provision with full wind turbine gearbox OEM capabilities, to offer customers a comprehensive supply and service package. As a result ZF now occupies a top three position in terms of global presence, with state-of-the-art manufacturing plants for gearboxes in China, Europe, India and the US. In the foreseeable future, the next step will be integrating the Hansen-designed products to help expand the ZF Wind Power portfolio with wind turbines from 1.5 to 6 MW capacity and beyond.

However, ZF’s rapid expansion to become a globally recognised original equipment manufacturer of wind turbine gearboxes has not been allowed to overshadow focus on the home market. Out of the media spotlight, ZF Services UK has continued to progress its three-stage expansion plan for its wind turbine gearbox overhaul facility in Nottingham. The second phase is now complete, doubling overhaul capacity by extending the workshop floor area, the travel of its 30-tonne crane and the productivity of its overhaul validation test rig. In a further reaffirmation of its continuing commitment to the UK’s wind energy industry, ZF Services UK has also signed up to the RenewableUK Wind Energy Charter, which sets out how the wind energy industry intends to deliver continued investment to the UK and its economy.

Apart from helping to minimise downtime by quickly identifying and solving problems on the spot, or even preventing them altogether, comprehensive field service enables operators to optimise their routine maintenance planning by incorporating regular on-site gearbox health checks.

www.zf.com/uk